SLICE PRO SIM
User's Manual

January 2014

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DTS Support

SLICE PRO systems are designed to be reliable and simple to operate. Should you need assistance, DTS has support engineers worldwide with extensive product knowledge and test experience to help via telephone, e-mail or on-site visits.

The best way to contact a DTS support engineer is to e-mail support@dtsweb.com. Your e-mail is immediately forwarded to all DTS support engineers worldwide and is typically the fastest way to get a response, particularly if you need assistance outside of normal business hours. For assistance by telephone, please go to http://dtsweb.com/support/techsupport.php to find the phone number appropriate for your region of the world.

Additional self-help resources and support material can be found at www.dtsweb.com. All DTS software installs user manuals to support a variety of products; these are available under the *Help* menu.

This manual supports the following products:

13000-72121: SLICE PRO SIM (9 ch), 100k, 200k filters (Option 21/Tajimi)
13000-72139: SLICE PRO SIM (9 ch), 100k, 200k filters (Option 39)
13000-72221: SLICE PRO SIM (18 ch), 100k, 200k filters (Option 21/Tajimi)
13000-72239: SLICE PRO SIM (18 ch), 100k, 200k filters (Option 39)
13000-75121: SLICE PRO SIM (9 ch), 50k, 100k filters (Option 21/Tajimi)
13000-75139: SLICE PRO SIM (9 ch), 50k, 100k filters (Option 39)
13000-75221: SLICE PRO SIM (18 ch), 50k, 100k filters (Option 21/Tajimi)
13000-75239: SLICE PRO SIM (18 ch), 50k, 100k filters (Option 39)
13000-75242: SLICE PRO SIM (18 ch), 50k, 100k filters (Option 42)

Introducing the SLICE PRO SIM

The SLICE PRO Sensor Input Module (SIM) is a high-speed, high-performance, industrial data acquisition system. The system is configurable and is supplied with either 9- or 18-channels. The SLICE PRO SIM supports many sensor types and sensitivities, interfacing with common and not-so common sensors.

This manual discusses the features and options available with the SLICE PRO SIM. To identify the specific hardware included with your system, please see your packing list.

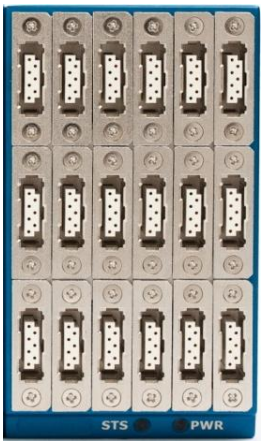
Overview of SLICE PRO SIM Features

- Sample rates up to 1 Msps on 9 channels simultaneously.
- Shock hardened to 100 g for dynamic testing environments.
- 9 or 18 sensor input channels, each with isolated excitation, high impedance differential input amplifier, and automatic sensor identification circuits.
- Internal battery with 1 hour capacity functions as primary or back-up power.
- LED indicators for power and system status.
- Easy control with the SLICE PRO USB Controller or SLICE PRO Ethernet Controller.
- Chainable with up to three other SLICE PRO modules.
- Each channel supports conventional bridge sensors or IEPE sensors.

Connector information and pin assignments can be found in Appendix A. Mechanical specifications are included in Appendix B. Appendix C provides typical sensor connection diagrams. Appendix D provides information on how to calculate data storage duration.

Sensor Connectors

The SLICE PRO SIM is available with LEMO 1B or Tajimi 7-pin sensor input connectors. See Appendix C for pin assignments and detailed sensor connection information.



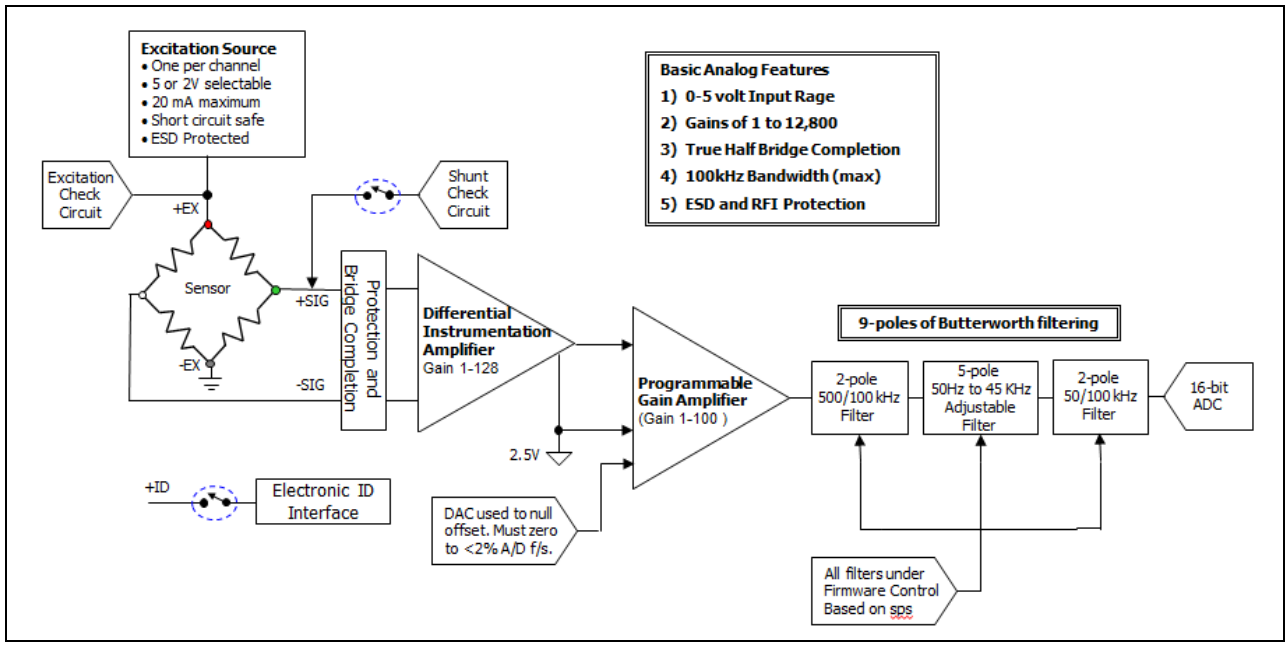
(18-channel SLICE PRO SIMs are shown; 9-channel units are also available.)

Supported Sensor Types

The SLICE PRO SIM supplies 2 V and 5 V excitation up to 20 mA and supports many types of sensors including accelerometers, load cells and pressure sensors. The following general sensor types are supported:

- Full (4-wire) or half-bridge (2- or 3-wire) resistive and piezo-resistive types.
- Voltage input: Input range 0.1 to 4.9 V; larger ranges with voltage expander circuit.
- Conditioned sensors with 5 V excitation and 2.5 V centered signal output.
- Common piezo-electric sensor types, including accelerometers, microphones and other charge-type sensors.

Common sensor configurations are shown in Appendix C. If you have further questions regarding what sensors are supported, please contact support@dtsweb.com and provide the sensor manufacturer and model number, if available.



SLICE PRO SIM Single Channel Block Diagram

Input Range

The nominal sensor input range is ±2.4 V at a gain of 1. At higher gains, the maximum range decreases correspondingly. For example, at a gain of 10, the input range is ±240 mV. (SLICEWare will automatically calculate the gain based on the user-specified input range and other sensor parameters.)

The nominal input range for an IEPE sensor is 0-24 V (±12 V) at unity gain. As with bridges, at higher gains, the input range decreases accordingly. For example, when the SLICE PRO unit applies a gain of 100, the input range will be 100 times smaller, or ±120 mV.

Excitation Sources
The excitation source for each channel is individually controlled and isolated. Excitation sources are not turned on until the software initializes the system during diagnostics. The bridge excitation can be set at 2.0 V or 5.0 V. The constant current IEPE excitation is fixed at 4.2 mA.

Bridge Completion
Bridge completion for any channel may be selected via SLICEWare. When chosen, a precision half-bridge is connected across +Ex, -Ex and +Sig. Therefore, half-bridge transducers should be connected to ±Ex and -Sig. The value of bridge completion resistors is 3,000 ohms, ±0.1%.

Hardware Filters
Each measurement channel has a 4-pole Butterworth anti-aliasing filter with one selectable –3 dB knee point. Two filter combinations are available: 50 kHz and 100 kHz, or 100 kHz and 200 kHz. Each channel also has a software-controlled, variable 5-pole Butterworth filter used in conjunction with the 4-pole Butterworth filters at lower sampling rates. SLICEWare automatically chooses the best filter setting for a given sampling rate. The relationship between sampling rate and anti-alias filter frequency is defined in the software configuration files. Please see the SLICEWare software manual for additional information.

Offset Compensation
Each channel can compensate for a sensor offset of up to 200% of the full-range output of a sensor. The sensor offset is measured and the hardware compensation is adjusted during SLICEWare's diagnostic check. Please see the SLICEWare software manual for additional information.

Sensor ID
Each measurement channel supports communication with silicon serial number devices manufactured by Dallas Semiconductor/Maxim Integrated Products for both bridge and IEPE sensors. When an ID chip is connected to the proper pins on the sensor connector, SLICEWare can automatically read these devices and correlate the serial number to channel set-up information stored in a Sensor Information File (SIF). (Note that sensor ID for IEPE is typically integrated into the sensor using the existing two-wire interface, and do not require a separate pin.)

Shunt Emulation
SLICE PRO SIM channels contain a shunt emulation circuit, effectively eliminating the need for conventional shunt resistors to perform shunt checks. When "Emulation" is chosen as the shunt calibration method within SLICEWare, the software injects a precisely-calculated current into the sensor to create an expected deflection of the sensor's output. This current, or voltage source, is a digital-to-analog converter (DAC) that allows the shunt emulation circuit to function as a shunt resistor. DAC settings are automatically calculated by the software to simulate 70-80% of the full-scale of the analog-to-digital converter. Please see the SLICEWare software manual for additional information.

Sampling Rates

The SLICE PRO SIM has user-selectable sampling rates up to 1 Msps. The available gains on any given channel are dependent on the sampling rate chosen by the user. The widest range of gains occurs at low sampling rates; the narrowest range of gains occurs at the highest sampling rates. If a sampling rate is selected that does not support the range and sensitivity of a particular sensor/channel combination, the software will alert the user. The following table shows the available gain ranges for three sampling rates, assuming the default 1:5 AAF-to-sampling rate ratio.

Sampling Rate	Input Range (Bridge)	Input Range (IEPE)
1 Msps	12.5-500 mV	±120-12000 mV (gain of 1-100)
500 ksps	3.9-1250 mV	
200 ksps and below	0.39-2500 mV	

Memory Size

With 16 GB of flash memory (15 GB available for data storage), the SLICE PRO SIM can record ~14 minutes of data at the maximum sampling rate (9 channels at 1 Msps or 18 channels at 500 ksps). Since the recording capacity is very large, it is generally best to limit sampling rates and event durations to the minimum necessary to avoid large and cumbersome data files. Large files take longer to download and may also be time-consuming to post-process or difficult to share. Use of the Region of Interest (ROI) download can save a great deal of time if implemented properly. For information on how to calculate recording duration, please see Appendix D.

UP/DOWN Interface Connectors

The UP interface connector allows the user to interface to either 1) a SLICE PRO Controller or other support interface, or 2) another SLICE PRO module. The DOWN interface connector allows the user to interface to another SLICE PRO module. Please see Appendix A for pin assignments.

LEDs

The SLICE PRO SIM has two LEDs. The status LED is red, green or blue and indicates communication and arm status. The power LED is red, green or blue and indicates power status. At system power up, the red-green-blue LED initialization sequence is performed by the status LED followed by the power LED.

LED behavior is summarized in the tables below.

STS LED Condition	State
Power up	
Communicating with PC (not armed)	

Recorder Mode	State	Circular Buffer Mode
Armed and waiting for Start Record signal to begin data collection		
Start Record signal received; recording data		Armed and recording data; waiting for Event signal
Event signal received (optional)		Event signal received
Data collection completed		Data collection completed

PWR LED Condition	System Power ON*	System Power OFF
Power up		
Connected to external power and unit is charging (power OK)		
Connected to external power and unit has fully charged		
Connected to external power; power fault		
Communication active with upstream module		

* These transitions do not happen if the unit is armed.

Basic Care and Handling

The SLICE PRO systems are precision devices designed to operate reliably in dynamic testing environments. Though resistant to many environmental conditions, care should be taken not to subject the unit to harsh chemicals, submerge it in water, or drop it onto any hard surface.

WARNING:

Electronic equipment dropped from desk height onto a solid floor may experience as much as 10,000 g. Under these conditions, damage to the exterior and/or interior of the unit is likely.

The SLICE PRO SIM is supplied with calibration data from the factory. DTS recommends annual recalibration to ensure that the unit is performing within factory

specifications. The SLICE PRO SIM is not user-serviceable and should be returned to the factory for service or repair.

When not in use or if shipping is required, we suggest that you always place the unit in the padded carrying case originally provided with your unit.

Shock Rating
The SLICE PRO SIM is rated for 100 g, 12 msec half-sine duration, in all axes.

Mounting Considerations
The unit should be securely bolted to the test article or dynamic testing device to provide the best shock protection. Mounting methods and hardware selection should be carefully calculated to withstand expected shock loading and facilitate proper grounding. Check bolt tightness periodically to ensure that 1) the unit is securely fastened to the baseplate, and 2) the baseplate is securely fastened to the testing platform. (See Appendix B for the unit's mechanical specifications.)

Thermal Considerations
The SLICE PRO systems are low power devices with negligible self-heating and it is unlikely that self-heating will be an issue in real-world testing. Should you have any questions about using SLICE PRO in your environment, please contact DTS.

Power Management

A good power source is of paramount importance. SLICE PRO SIMs should be powered from a SLICE PRO Controller. (One Controller can support up to 4 SLICE PRO modules.) Be sure to consider any power drop due to cable length.

	Input Voltage, System OFF/ON	Input Current, System OFF*	Input Current, System ON**
SLICE PRO Controller	11.5-16 VDC	500 mA per module***	1 A per module***

* charging all internal batteries ** fully armed + charging all internal batteries
*** Controllers are considered modules for the purposes of power calculations.

Power Consumption
Power off: When connected to sufficient external power, the SLICE PRO SIM will draw up to 500 mA for charging the internal battery.

Power on: When the SIM is initially powered, all sensor excitation sources, calibration circuitry, signal conditioning sources, adjustable filter circuits are in a shutdown state. When the user runs a test set-up, the software automatically energizes these circuits. The current draw per module will increase from ~625 mA to as much as 1 A when the system is fully armed and powering 350 ohm bridges with 5 V excitation.

During data collection: Once the system has been armed for data collection, all circuits remain in a full power state until data collection is finished. After the data

collection routine has completed, the SIM de-energizes the signal conditioning, excitation and filter circuits to minimize power consumption.

Internal Battery

The SLICE PRO SIM contains an internal 7.4 V (nominal) lithium battery that operates as primary power or back-up power should primary power fail. When fully charged, battery capacity is sufficient to provide primary power and sustain full operation for 1 hour. It charges whenever sufficient external power is connected to the module via a SLICE PRO Controller. The maximum charge time is 3-4 hours from complete discharge to full capacity. The module does not need to be ON in order to charge the internal battery.

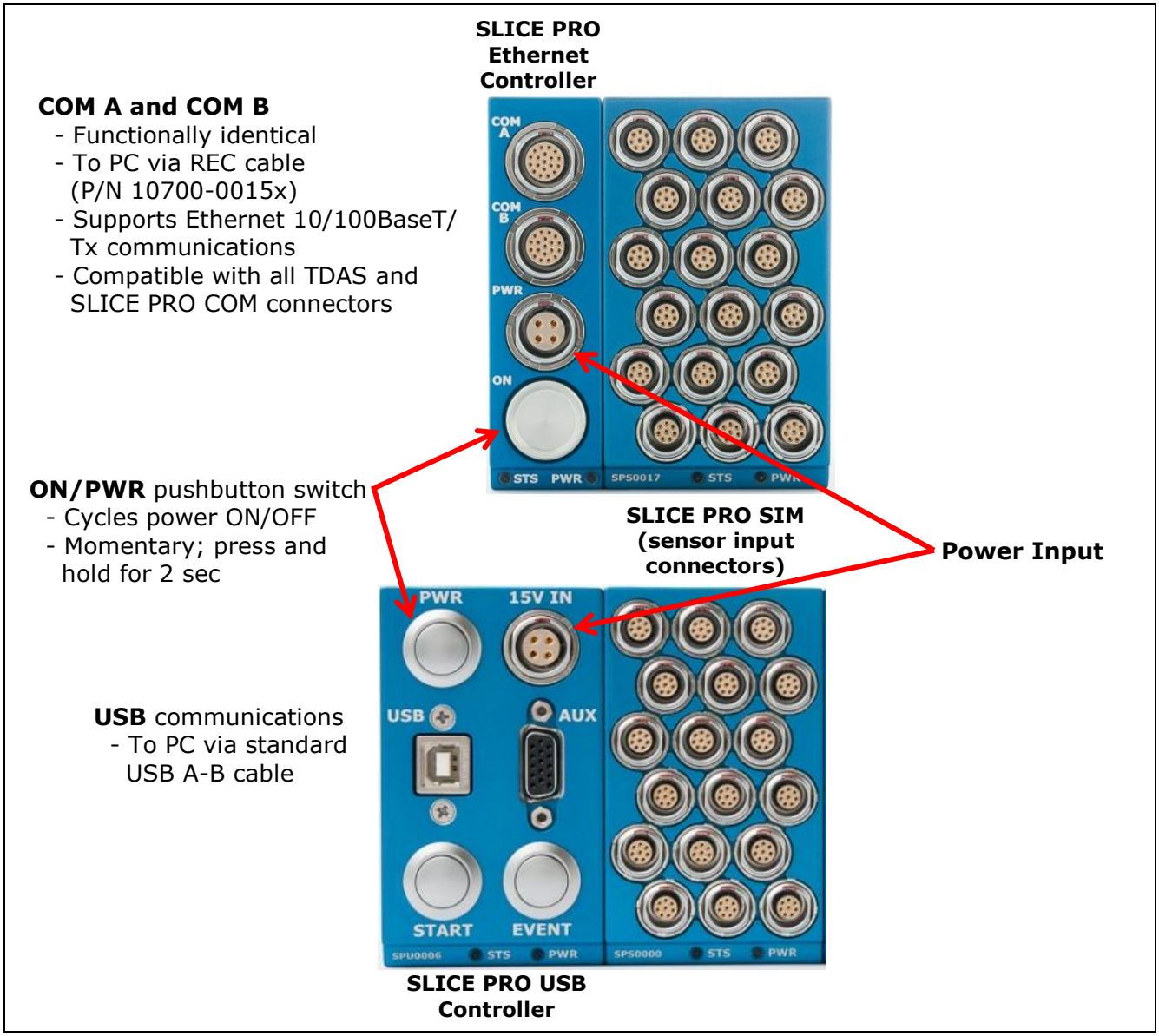
Charging practices can affect the useful operational life of the battery. In addition to good charging habits, conditioning the battery may be useful—three deep-discharge/recharge cycles may help increase battery performance. The battery's useful capacity is greatly shortened near the end of its service life and should be replaced when it has decreased to 50% of its initial capacity. The battery is not user-serviceable and should be returned to the factory for battery replacement.

Power-up and Power-down Procedures

The SLICE PRO SIM is powered up when the proper signal is connected at the UP interface connector. This is typically accomplished via a SLICE PRO Controller. Power-up of the module takes 5 seconds to 2 minutes (this depends greatly on the type of Controller in use), after which communication is enabled. To restart, turn off the system and wait ~30 seconds before reinitializing. If a system is armed for data collection, it will remain on until it is disarmed or power reserves are exhausted. An incomplete power-down/power-up cycle can result in errors, so be certain to follow proper procedures.

Communication Features

Communications with the SLICE PRO SIM is accomplished via 1) a SLICE PRO USB Controller and USB comm cable (USB A to USB B) or a SLICE PRO Ethernet Controller and Ethernet (REC) comm cable (P/N 10700-0015x), and 2) a PC running SLICEWare version 1.08 or higher. Please see the SLICE PRO USB Controller or SLICE PRO Ethernet Controller User's Manuals for additional information.



SLICE PRO System Set-up

Data Collection Concepts

The discussion below provides a general introduction to data collection. Please see the SLICEWare 1.08 User's Manual for a detailed discussion and implementation specifics.

SLICE is a standalone data logger. Once the system is armed, the PC can be disconnected if desired. After receiving a Start Record or Event signal, SLICE autonomously collects data, storing it to flash memory with no user interaction. After the test, the user can reconnect the PC to download the data.

There is also a real-time mode in the control software that allows the user to check channel inputs on an oscilloscope-looking screen. (This data can be logged.)

Data Collection Modes

SLICE supports four data collection modes: Circular Buffer, Recorder, Hybrid Recorder, and Continuous Recorder. (Note: SLICEWare cannot simultaneously display the data while the system is recording.)

Circular Buffer Mode

Using Circular Buffer mode, the user can program SLICE to record pre- and post-Event data. Time Zero (T=0) is marked when the Event signal is received.

Recorder Mode

Data collection begins when a Start Record signal is received and continues for the time specified in the test set-up. If an Event signal is received sometime after the Start Record, this is marked as T=0.

Hybrid Recorder Mode

Data collection begins when a Start Record signal is received and continues until the unit receives an Event signal. The unit then records for the post-Event time specified by the user. The Event signal marks the T=0 point and all data recorded is available for download.

Continuous Recorder Mode

Data collection begins when a Start Record signal is received and continues until the Start Record signal is released. The unit will then re-arm for another event. The LEDs on the unit will flash blue slowly then rapidly, and then the status LED will become solid blue, indicating the unit is fully armed. The unit will continue to record new events until it records the number of events specified by the user. If an Event signal is received after the unit has re-armed, the unit will disarm and no longer attempt to re-arm.

Start Record and Event Initiation

The SLICE PRO SIM supports multiple methods of initiating Start Record and Event signals. Typically, Start Record and Event are initiated via an external hardware interface that provides a discrete contact closure (CC) signal to initiate recording (Recorder mode) or mark T=0 (Circular Buffer mode).

All SLICE data collection modes have a multi-event arming mode. A unit armed in a multiple-event mode will re-arm when an event completes. The unit will stop re-arming when the number of events specified by the user has been recorded.

SLICE can be placed in an auto-arm mode that will cause the unit to arm automatically when the power is cycled. This available with any data collection mode.

Additionally, Circular Buffer mode supports level triggering. This method continuously samples the incoming data and begins data collection if the data is above or below predefined levels. For example, it might be useful to begin data collection when a certain accelerometer experiences a force above 200 g. Using level trigger, and Circular Buffer mode, the SLICE PRO SIM can support this or any level-trigger signal on any channel.

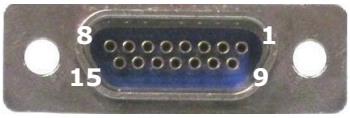
Finally, if the SLICE PRO SIM remains connected to the PC during data collection, the control software can be used to begin data collection.

The table below summarizes the data collection modes and event/triggering options.

	Supports T=0 Start Record	T=0 methods supported	Data record window
Circular Buffer	Yes	Hardware (CC), software (PC) or level trigger	User-defined pre- and post- T=0 durations
Recorder	Yes	Hardware (CC), software (PC) or level trigger	User-defined duration after T=0
Hybrid Recorder	Yes	Hardware (CC), software (PC) or level trigger	User-defined post-Event duration
Continuous Recorder	Yes	Hardware (CC), software (PC), or level trigger	User-defined duration after T=0, with recording multiple events possible

Appendix A: Connector Information

UP interface connector*
(Omnetics A99077-015;
MMDS-015-N06-SS)



(panel view)

DOWN interface connector
(Omnetics A98000-015;
MMDP-015-N00-SS)

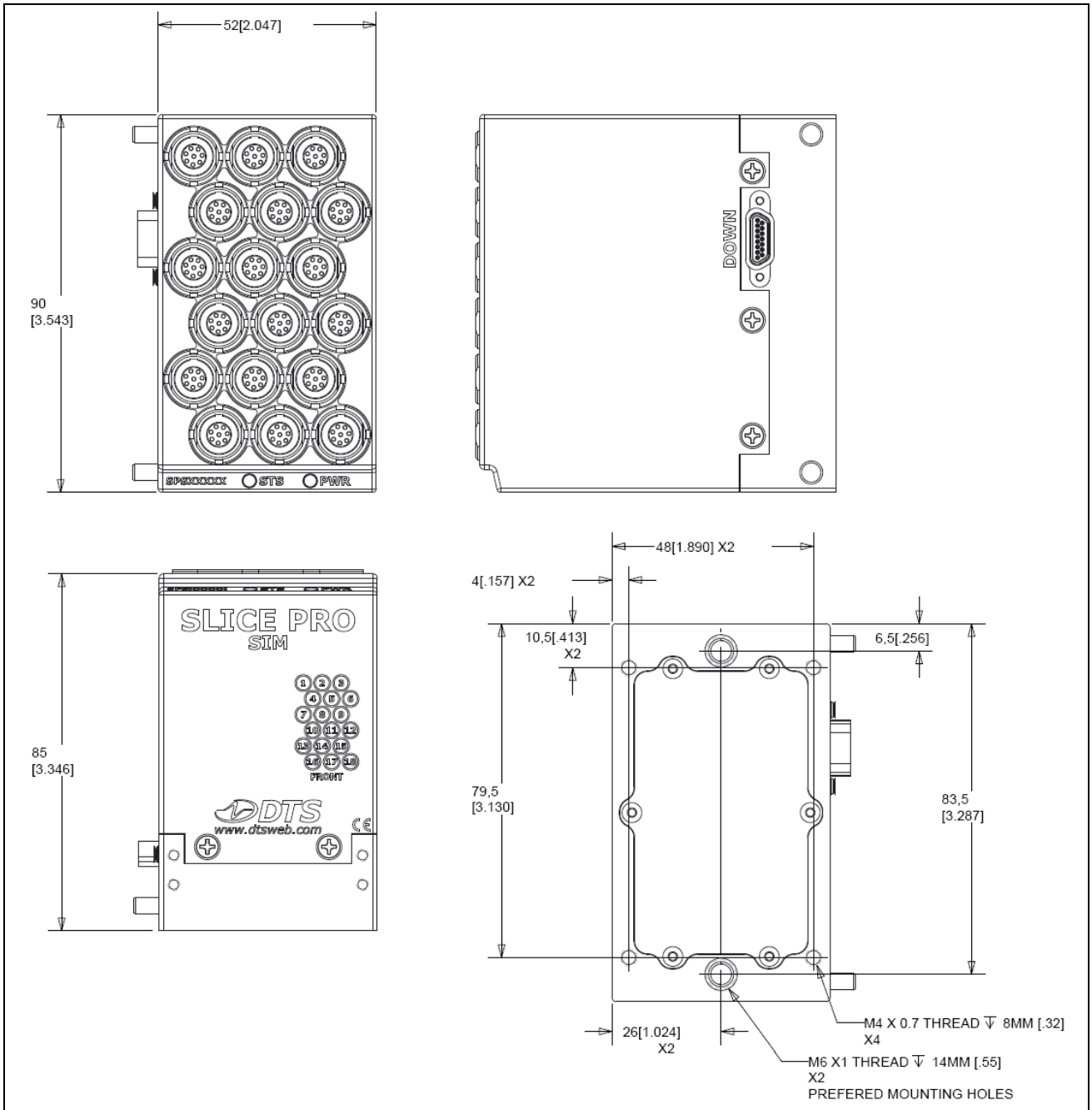
(panel view)

Pin	Function
1	12.6 VDC in (UP)/out (DOWN)
2	12.6 VDC in (UP)/out (DOWN)
3	Ground
4	Ground
5	/ON (CC input to ground)
6	/EVENT (CC input to ground)
7	/START (CC input to ground)
8	Status input (UP)/output (DOWN) (5 V via 10k with respect to ground)
9	12.6 VDC in (UP)/out (DOWN)
10	12.6 VDC in (UP)/out (DOWN)
11	Ground
12	Ground
13	USB_DP
14	USB_DM
15	USB power

* The UP connector may appear loose. Do not tighten.

Appendix B: Mechanical Specifications

Weight: ~425 g (15 oz)

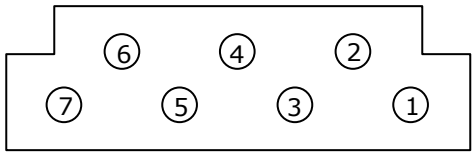


Units in mm (inches) Torque spec: 84 in-lb (M6)

Appendix C: SLICE PRO SIM Sensor Connections

SLICE PRO SIM

3RT01-R7F



(panel view)

(Suggested cable connector P/N: 3RT01-PE7M)

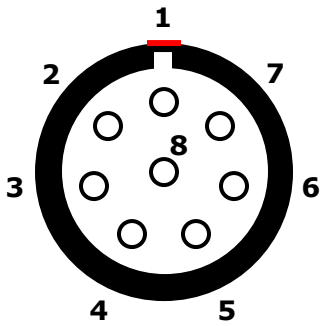
Pin assignments: Option 21*

1	2	3	4	5	6	7
+Ex	Shld	+Sig	-ID	-Ex	+ID	-Sig

* IEPE not supported with this option.

SLICE PRO SIM

EEG.1B.308.CLL



(panel view)

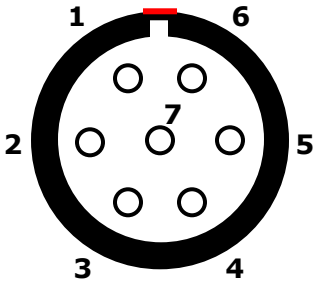
(Suggested cable connector P/N: FGG.1B.308.CLAD42)

Pin assignments: Option 39

1	2	3	4	5	6	7	8	Case
-Ex	+Ex	-Sig	+Sig	-ID/Shld	+IEPE	-IEPE/Shld	+ID	Shld

SLICE PRO SIM

EEG.1B.307.CLL



(panel view)

(Suggested cable connector P/N:
FGG.1B.307.CLAD42)

Pin assignments: Option 42*

1	2	3	4	5	6	7	Case
-IEPE/-ID	+ID	+Sig	+Ex	-Ex	-Sig	+IEPE	-ID/Shld

* Compatible with legacy TDAS option A sensors if external shunt resistors are not installed.

Appendix D: How to Calculate Data Storage Duration

With 15 GB available for data storage, there are a total of 7,500 M samples available in each SLICE PRO SIM (1 sample = 2 bytes). All data channels are recorded even if they are not needed for your test.

To determine the recording time possible given the number of channels and sampling rate, use the equation below:

$$\frac{7{,}500{,}000{,}000}{\text{Sampling rate (sps)}^* \quad X \quad \text{\# of channels}} = \text{\# of seconds}$$

* Note: The maximum sampling rate for 9 channels is 1 Msps; the maximum sampling rate for 18 channels is 500 ksps.

Example 1: 100,000 sps using 9 channels

$$\frac{7{,}500{,}000{,}000}{100{,}000 \quad X \quad 9} = 8{,}333 \text{ sec (2.32 hours)}$$

Example 2: 25,000 sps using 18 channels

$$\frac{7{,}500{,}000{,}000}{25{,}000 \quad X \quad 18} = 16{,}667 \text{ sec (4.63 hours)}$$

Revision History

Date	By	Description
13 Jan 2014	EK	Revised IEPE input range (under Sampling Rates) and Appendix D. (Rev 1)
13 Dec 2013	GG/TK/EK	Initial release. Copied 13000-70139-MAN (Dec 2012) and updated for SLICE PRO SIM Gen2.5. (Rev 0)